Technology Opportunity

Using Electronic Holography for Inspection of Turbomachinery

The National Aeronautics and Space Administration (NASA) seeks to transfer a visualization method for showing potential and actual damage sites in the components of rotating machines. Some elements of the method are still being developed.

Potential Commercial Use

Nonintrusive inspection for
- Potential damage sites in rotating components, such as impellers
- Actual damage, such as cracks or disbonds

Benefits

- Allows rapid, in situ visualization of potentially damaging vibrational modes.
- Allows detection of actual damage in metals and composites.
- Allows nondestructive inspection of machinery components.
- Permits comparisons between designed and measured vibrational mode shapes.

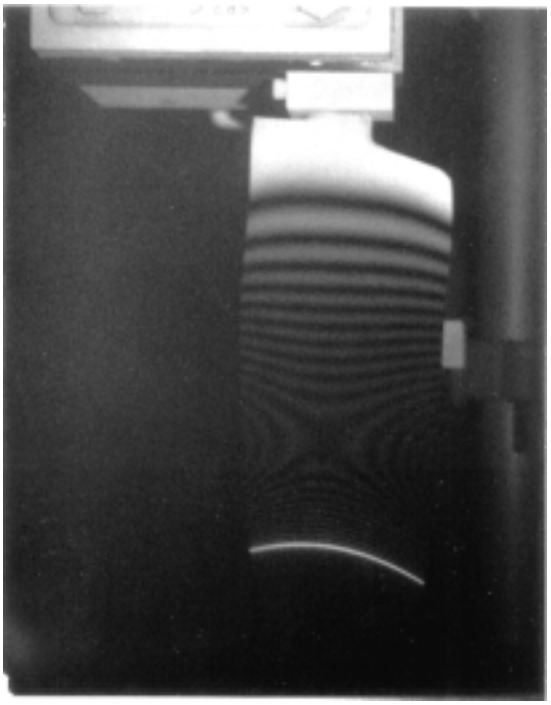
The Technology

Time-averaged holography has been used for more than 30 years to detect and visualize vibrational modes. Electronic holography, which in the 1990's replaced the old photographic emulsion method of time-average holography, allows rapid identification and visualization of a structure's vibrational modes. The NASA Glenn Research Center uses, and is improving, electronic holography.

Holograms of vibrating structures show a characteristic pattern. The figure shows such a pattern for a turboprop blade. The bright regions, or nodes, are regions of high stress and potential damage. To prevent damage, designers need to prevent the excitation of vibrational modes in rotating machinery.

The characteristic patterns show regions where damage might occur. But the pattern of the bending-induced strain of a vibrating object is much more effective for showing actual damage. The characteristic patterns must be transformed to patterns of bending-induced strain so that damage can be visualized.

Glenn researchers are developing artificial-intelligence "neural networks" for transforming characteristic patterns into bending-induced strain patterns. These neural networks are being "trained" with the finite element models used to design the actual structures. Electronic holography permits



Characteristic pattern of turboprop blade.

rapid visualization of potentially damaging vibrational modes, and neural networks augment rapid visualization of damage already present.

Options for Commercialization

Glenn has demonstrated applications of electronic holography to structures provided by several manufacturers. A limited number of such tests and demonstrations can be performed. These tests will include all upgrades as they become available. The current policy is to publish new knowledge about electronic holography or neural networks (but not about specific structural tests) in the open literature.

Contact

Commercial Technology Office
Attn: TOPS
NASA John H. Glenn Research Center
at Lewis Field
Mail Stop 7–3
Cleveland, OH 44135–3191
Phone: (216) 433–3484
Fax: (216) 433–5012
E-mail: cto@grc.nasa.gov
http://cto.grc.nasa.gov

Key Words

Vibration
Strain
Cracks
Electronic holography
Neural networks
Nondestructive evaluation

References

IC-031-1
CD-96-73492

National Aeronautics and
Space Administration
Glenn Research Center